

REMARKS

Claims 1 and 6-8 remain pending. Reconsideration of the application is requested.

The Examiner rejected claims 1 and 6-8 under 35 USC 103 (a) as being obvious on consideration of Konecny in view of Nishiyama.

Konecny discloses a motor 10 having an external permanent magnet rotor assembly 12 and an armature 18 serving as the stator disposed inside the rotor assembly with an annular radial gap 26 defined therebetween.

Nishiyama discloses a motor having an inner rotor and an outer stator.-

The Examiner indicated "It would have been obvious to one skilled in the art at the time the invention was made to use the motor disclosed by Nishiyama et al. with on (sic) the compact three-phase permanent magnet rotary machine disclosed by Konecny for the purpose of producing an inductance difference between the q-axis inductance and the d-axis inductance, so that it is possible to rotate and drive the rotor by making use of the reluctance torque"

In the "Amendment" dated December 17, 2003, Applicant discusses the importance of issues like cogging torque, torque ripple, and inertia to the very important synergistic effect of "steering feel or touch" for an electric motor used for steering assist in an electric power steering apparatus. Applicant states:

Thus, it is clear from the "Background of the Invention" that it is important to reduce fluctuations in the steering torque or torque ripple, reduce cogging torque which then helps to reduce torque ripple, and reduce rotor inertia to enhance responsiveness and, consequently, enhance a comfortable steering touch or feel.

In considering Nishiyama, it is clear from the disclosure that extensive experimentation was done by the inventor. For example, at column 5, lines 40-46, it is stated:

The slight gap d in embodiment 1 is $0 < d < 0.2\text{mm}$. The slight gap d is formed by assembling after winding on the core element 5, and by opening such small gap, the magnetic leak from the winding of the slot 8 can be suppressed, and the cogging torque becomes smaller. The gap d of $0 < d < 0.2\text{mm}$ is a value obtained by experiments, and the cogging torque is decreased efficiently at this value. ... (emphasis added)

Then at column 6, lines 43-46, Nishiyama states:

Incidentally, it was found by experiments, that the torque ripple is decreased when the width of the adjacent permanent magnets is 0.15 to 0.20 of the width of the teeth confronting two magnetic poles ... (emphasis added)

Thus, Nishiyama did experiments for the purpose of reducing cogging torque. Nishiyama also did experiments for the purpose of decreasing torque ripple. Nishiyama filed his priority application in 1996, nine years after filing of the application by Konecny. Nishiyama, however, was not able to identify the steering motor configuration of Applicant's claim 1; namely, an annular outer stator with 9 poles, an inner rotor of permanent magnets of 8 poles, a stator winding grouped to be driven by electric power of three phases such that the windings are positioned to be every other one, as in claim 1, and connected in series or, as in claim 7, positioned adjacent to each other. The Examiner suggests that the disclosure of Nishiyama could be used for the purpose of introducing the motor of Konecny. The motor of Konecny, however, is disclosed with an outer rotor which is well known to have high inertia. Applicant as indicated in the above discussion in the December 17, 2003, Amendment, was trying not only to reduce torque ripple and cogging torque, but also reduce rotor inertia. Why would Applicant consider the high inertia, outer rotor motor of Konecny as an improvement to the motor of Nishiyama who had already done considerable experiments with his configuration to decrease cogging torque and torque ripple? Furthermore, Konecny in the table in column 4 discloses numerous configurations of "Ferri-magnetic Poles" and "Permanent Magnet Poles". How would it be known which configuration to use without even more experimentation? Nishiyama, with his inner motor, is not logically considered with Konecny, with his outer rotor. These are two different types of motors. Nishiyama did not discover the motors of Applicant in 1996 after much experimentation, even though Konecny was disclosed some nine years earlier. It is only in hindsight after seeing Applicant's motors as claimed in claims 1 and 7 that it is

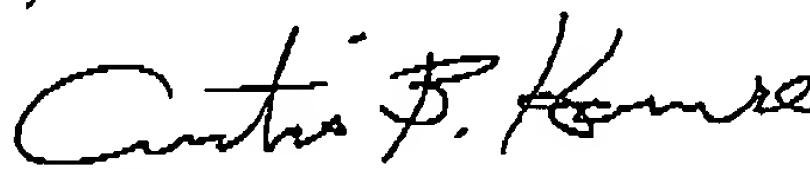
possible to think of Applicant's motors without further extensive experimentation. A prima facie case of obviousness has not been made. Claims 1 and 7 and the claims which depend from them are non obvious.

In view of the above, it is submitted that the application is in condition of allowance. Reconsideration and reexamination are requested. Allowance of claims 1 and 6-8 at an early date is solicited.

Respectfully Submitted,

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